the veins, causing also an increase in the number of the white corpuscles in the splenic vein. Ergot had no effect.

We noticed the following variation in the globular richness during the administration of quinia.

Globular richness of a healthy male adult at 2 P. M., half an hour after a slight lunch.

Red corpuscles . . .	3,249,600
White corpuscles . . .	5,754
Ratio	1 to 566

The next day at 10 A. M. .97 gramme quiniæ sulph. was given, causing, from 1 to 3 P. M., a slight effect upon the nervous system. Half an hour after a lunch (the same as on the previous day) at 2 P. M. the count was

White corpuscles . . .	8,300
Red " . . .	——

The red corpuscles were not increased, the exact figures, however, were mislaid.

On the next day 1.29 grammes quiniæ sulph. were given at 10 A. M., and at 2 P. M. the effects of the drug, tinnitus aurium, slight giddiness, some nervous excitement, were quite marked. An examination showed the

Red corpuscles to be . . .	2,978,600
White corpuscles to be . .	12,186
Ratio	1 to 245

On the next day no quinia was taken; lunch at the same time; at 2 P. M. the

Red corpuscles numbered .	3,422,902
White corpuscles numbered .	5,575
Ratio	1 to 613

The habit of life during these four days was exactly the same; the lunch was exactly the same.

We have made no special investigations of the effect of quinia given in diseased conditions. In one case of syphilis which we observed there was a marked increase in the red corpuscles, 1,043,130 under the administration of cinchonæ sulph.

There was therefore in health a slight *diminution* in the number of red corpuscles, and a marked *increase* in the number of the white after the administration of a large dose of quiniæ sulph.

Article V.

Parotiditis, or Mumps; A Theory of its Etiology, and the Rationale of the Secondary Manifestations, or so-called Metastases. By A. B. Isham, M.D., Professor of Physiology in the Cincinnati College of Medicine and Surgery.

Parotiditis, or mumps, is a disease which primarily affects the parotid gland, usually first upon one side, and in a day or two extending to the other. Both glands, however, not uncommonly become involved at the same time; or, more rarely, one gland only may be attacked, the other remaining unaffected until another disease visitation. Consecutively, the submaxillary and sublingeal glands are very often implicated. It is a disease which, as a rule, occurs but once in the same individual. The exceptions to the rule, when both glands have been the seat of the disease, are very rare.

As regards etiology, nothing has been developed since the days of Hippocrates. It appears in all seasons, but is most prevalent in fall and winter. It occurs in mountain districts, table lands, valleys, lowlands, islands, and upon ship-board. It is not confined within degrees of latitude and longitude. It prevails as an epidemic, or rather as an endemic, and sporadic cases are met with. The latter fact tends to negative any agency in causation of atmospheric and telluric influences.

Its well-known outbreak among new recruits in camps, among the inmates of boarding-schools and institutions, when no cases have been known to exist in the immediate neighbourhood, would point to the food as an etiological element. In the case of recruits, at their homes they were accustomed to soft food, which they "bolted" with but little mastication, and consequently little stimulation of the salivary gland secretion. Furnished with the army biscuit, or "hard tack," however, all the masticatory strength is called forth. This mechanical stimulus of jaw movement is supplemented by that of the dryness of the cracker. The secretion excited must be much more than that excited by a dry bread-crust, which has been found by Tuczek to be equal to the bulk of the crust. The secreting gland-cells, under this excessive and unusual secretion, become distended, and finally they are separated from the basement membrane, filling up the tube, and causing salivary retention. In consequence of the gland no longer equalizing pressure in the bloodvessels by removing fluid, effusion takes place into the connective tissues or lymph spaces, and the gland swells. This simple process may or may not be accompanied by inflammation. Analogous changes occur in the kidney tubules, consequent upon great blood-pressure from any cause.

The fact that both parotids are very often not affected simultaneously is not opposed to this view. In truth, it affords an easier explanation than the contagious catarrhal theory of causation. It is well known that in many persons mastication is principally one-sided. Physiologists have also shown that the secretion of saliva occurs upon the side of mastication. Where the two glands have been stimulated unequally by one-sided mastication, the one which has furnished the bulk of the secretion is first involved, the ducts being filled up by cast-off epithelial cells, and compressed by the pressure of effusion. The other gland then assumes the secretory function for both, but from having been functionally inactive, and from the burden of work so suddenly put upon it, proves unequal to the office. The same alterations now transpire as in the other gland, obstruction, effusion, and enlargement, with perhaps inflammation. The advocates of the catarrhal hypothesis put in the plea of "extension of the irritation." Which is the more rational explanation? Where both sides have been equally operated upon by secretory stimuli they are attacked at the same time.

It is admitted that this idea of etiology receives its strongest support in its application to endemics in camps and institutions where the same diet obtains for all. Yet those endemics occurring in communities of individual families, and the sporadic cases presenting everywhere, while seemingly in opposition, are not without the range of such causation. While the separate families of a community live and cook differently, they are still dependent upon the same sources of food supply, and the substantial articles of nutriment are the same for all. Food varies in its constitution according to season, care, culture, etc.; the more solid matter it contains the greater the quantity of salivary fluid needed to moisten and act upon it. The source and quantity being the same, it is evident that it must act about the same in each family of the community, although modified in some by the mode of preparation. Here most of those not protected by a previous experience will be affected, but others obnoxious to the trouble may escape by reason of special diet, manner of food preparation, or from constitutional states having a bearing upon the quantity of food ingested. Sporadic cases may occur through causes pertaining to the individual, such as habits of chewing wax, dry wood, rubber, tobacco, etc., eruption of the teeth, or other processes acting as a stimulus to the salivary secretion. These etiological elements also belong to endemic visitation. Or they may be induced by individual peculiarities, certain articles of food affecting solitary individuals while they are inoperative upon the mass.

But this view must fail of acceptation if it is not competent to furnish a solution to the problem of non-recurrence, or why the affection never, or very seldom, recurs in the same individual. Without this it stands equal with the contagious catarrhal theory; but this is not enough. There is a physiological law that the development of an organ must be proportionate to the amount of work it has to perform. An attack of specific parotiditis indicates that the gland involved has not attained to the fulfilment of this law, and the completion of development is at once begun. New vesicles and lobules branch out, new epithelium cells are formed. Under the influence of this formative force, effusions and waste products are disposed of, and the gland reaches its acme of development, and is equal to any amount of work it may in the future be called upon to perform.

Favouring the representation that the process is one of development is the fact that cases of mumps are most common about the period of puberty when such developmental alterations ensue in other organs. The analogous changes are those taking place in the testicles, ovaries, and mammæ. In the latter innumerable ramifications branch off from the ducts and some vesicles are formed. In the testicle the seminiferous tubes increase in size and the seminal cells or vesicles are developed. In the ovaries the follicles and ova become enlarged.

Instances of very early ovulation and mammary development are not by any means wanting, as every one knows. Is it, therefore, astonishing that the affection known as mumps, which marks the full development of the salivary glands, should occur more frequently than the mentioned changes in the organs above named, between the age of two years and puberty, when we consider the thousand times greater exercise and stimulation to which they are subjected?

The disturbance therefore should take place more often about the period of puberty, because this is the time when general changes are proceeding in the organism. It is then that the system is most sensitive to extraneous influences and the salivary glands not less than other portions. That the parotid affection may not rarely be delayed for years beyond this time does not seriously militate against the proposition. The retardation of development in the mammæ and ovaries consequent upon morbid states as phthisis, epilepsy, scrofula, etc., is familiar. Such instances serve to illustrate the fact that processes may manifest a selection for parts or organs of the body, and through their operation there interfere with actions in other parts or organs. Thus the alterations in the generative organs and apparatus of lactation, consequent upon the advent of puberty, may be so active as to consume all the formative force in the organism, and the salivary glands will remain as before. The longer after puberty, however, the change is delayed the more marked is likely to be its reaction upon the system, because, after this time the body elements tend to become more and more fixed. It is this which gives significance to the popular expression, "the mumps go hard with grown people."

We come now to consider the so-called metastatic phenomena of the affection. Where these occur it is usually five to eight days after the commencement of the parotid trouble. In the matter of frequency as gathered from writers, parts become involved in about the following order: testes, mammæ, ovaries, labia majora, lymph glands, spleen, and brain. Leichtenstern (*Handb. d. Kind. Krankh.*) mentions nephritis and catarrh of the bladder, urethra, and vagina as rare occurrences. Dr. Dunn (*North of Eng. Med. and Surg. Journ.*, and *Amer. Journ. Med. Sci.*, 1831) reports four cases of mumps with inflammation of vagina and purulent discharge following. While it is asserted by some systemic writers that transference of the disease process to the ovaries never transpires, others place it next in frequency after affection of the mammæ. The literature of the subject is exceedingly scanty. No citation of cases is given in works, and we have only found three cases reported in the journals, two by Damorest, and one by Meyner (*Clinic*, Oct. 1876). On the other hand, while in all the treatises involvement of the mammæ in females is placed next in order of frequency to the testicles in the male, no references are given. After examination of a wide range of journals, English and German, we have not been fortunate enough to find a single case recorded where these organs were implicated. Can it be possible that the authority of the traditional "old woman" was first accepted for this complication without credit, and so has been seized upon by one author after another? Rilliet, who has given us the most complete description of parotiditis extant, did not observe a single case of enlargement of the mammæ, and other writers specifically state that they have never met with it. We, therefore, believe that the ovaries are more frequently affected from parotiditis in females than other organs in this sex, but from the well-known obscurity of the symptoms, or from the modesty of these persons, it is not detected. Irritation of the stomach and intestinal tract is not specifically noticed, but that it occurs, the symptoms of anorexia, nausea, fever, and diarrhœa in many instances abundantly exhibit.

No example has been recorded as far as our investigation has been carried in which parotiditis had a relation to endocarditis, and the opportunity of supplying this hiatus is embraced by offering the following from our note-book.

Carrie M., æt. 4 years, brought to office Aug. 2, 1873, complains of lassitude; feverish in the afternoon and evening; no appetite; tongue slightly coated; bowels regular. Suitable medication prescribed. 3d. Condition about the same. 4th. Missed her fever and she was seen no more until the 7th when I was called in on account of a swelling in the right parotid region. The parotid of that side was regularly enlarged and firm. No congestion of pharynx and fauces. There was no fever. On the 8th both parotid regions were swollen and she had fever. The urine was high coloured, and upon examination was found to contain blood disks, tube casts, and to be albuminous. On the 9th her mother assumed the responsibility of taking her a walk through Eden Park. Called to her in the night. There was violent fever, delirium, dyspnœa, excited action of the heart, visible heaving impulse, and a murmur having the characters both of a blowing and a friction murmur, double with reference to the sounds but most plainly systolic as nearly as could be distinguished under the very rapid action. There was also discovered some amount of ascites. These morbid appearances all disappeared under treatment and time, good recovery ensuing.

It thus appears that any organ of the body except the liver and lungs, may become the seat of what has been termed a metastasis in mumps. Why these organs apparently are exempt, others nearly so, and yet others specially selected to share in the morbid expression it will be the endeavour to elucidate. In doing so it will be first necessary to inquire what influence the parotid secretion retained in the blood might exert upon the system. At the very commencement it must be confessed that nothing is really known respecting the vital chemistry of the salivary secretion further than that it forms from the blood ptyalin, a ferment which induces a saccharine conversion of starch, together with sulpho-cyanide of potassium, and the sodium and potassium chlorides and phosphates. It is to be held as an excretory product of the nutritive fluid, for, although it is reabsorbed, yet, from contact with food and digestive juices its principles have undergone such metabolism that they are wholly changed. Being thus entitled to esteem it as an excretion it may be assumed to bear a comparison with other excretions, the retention of which in the circulating fluid we have definite information concerning. Taking the quantity secreted daily by an average adult man, which is calculated at about three pints, it has an important place among the excrementitious fluids.

Classing the *peculiar* salivary constituents, then, as matters to be separated from the blood, it follows that their retention in the blood or their entrance into it as salivary principles would be productive of mischief. When the urinary excretion is arrested, there are present the morbid appearances designated as uræmia. When the biliary flow is impeded, the condition recognized as cholesteræmia or jaundice ensues.

But before proceeding further it may be as well to establish that salivary retention occurs. Bouchet declares that parotiditis is simply salivary retention due to catarrhal inflammation of the excretory duct of the parotid gland. Virchow holds it to be an inflammation of the gland ducts with salivary retention and œdema of the interstitial tissue. These are about the only emphatic utterances met with. That an inflammatory condition of the duct or of the gland may set up is no wise opposed to the etiology and pathology advocated in this paper.

The question immediately arises, if salivary retention may prove so hurtful why is it that every case of mumps is not accompanied by more serious disturbances? This inquiry may be satisfied by a reference to the fact that the submaxillary gland secretion although more viscid contains the same principles as that of the parotid, and that under disability of the latter, the former, together with the sublingual, may perform its depurative function. Of some interest here are the results of the experimentation of Heidenhain upon dogs. He found that galvanic stimulation of the chorda tympani produced a watery secretion, and that under long-continued excitation of the sympathetic, the submaxillary secretion acquired the watery consistence of the parotid fluid. When, however, the submaxillary and sublingual glands become involved in addition to the parotids, we have absolute retention, with entrance into the blood of the salivary principles. Then marked evidences of systemic infection should be expected and they do occur; these are the so-called metastases.

The meaning conveyed by the term *metastases* is that there is a sudden shifting of the process from one point to another with complete removal of morbid action from the original seat. The majority of writers assert that they have never observed a sudden resolution in one part coincidently with a spread to another, and they believe that it occurs very exceptionally or not at all. They have only noticed the same gradual subsidence in the parotid, under such circumstances, as usually occurs without complication, in six to ten days from commencement of swelling. The metastatic phenomena also gradually disappear in a like period of time. Since the *materies morbi* are retained excretory products in the blood, as herein set forth, these principles are carried in the blood stream to all organs of the body and they may, at any time, create a disturbance in any part without a transposition of all the disease appearances to this locality. There is really no metastasis, as we interpret this term, the outbreak in a part remote from the original seat simply being an expression of a systemic poison. The involvement of a new organ, as the testicle, may occur just at the subsidence of the parotid swelling as well as at any other time, and this is likely what has given rise to the idea of metastasis or sudden transference.

We are now brought to the task of showing why parotiditis is not more frequently attended with complications, why some organs do not become implicated at all, and others are specially obnoxious to the action of the morbific material.

The lungs owe their exemption to the office which they perform in blood depuration. Sugar, a substance which when present in quantity in blood occasions the fatal disease diabetes, is destroyed by passage through the lungs. Sulphuretted hydrogen when present in the air, even in minute quantities, is fatal to birds; but when it is injected into the blood, it is at once eliminated by the lungs, and no harm ensues. Not only are the pulmonary structures protected by this depurative function of the respiratory apparatus, but it exerts a protective influence also over all other parts of the body. Where the noxious matter is not too great, it may all be eliminated by the lungs in connection with the liver, kidneys, skin, and alimentary tract and complications be prevented.

The liver also is indebted for its freedom from disturbance to the same property it possesses of separating deleterious substances from the blood. Schiff has recently demonstrated by experiment that a dose of nicotin sufficiently large to kill a large dog, if injected into the general circulation, only produced feeble symptoms of poisoning when injected into the mesenteric veins and small intestines of other dogs. A double dose, passed through the liver before entering the general circulation, did not kill a dog. On the other hand, an injection five times diluted killed an animal in which the portal vein was tied. Cholesterine, too, a poisonous product, is removed by the liver. It is evident that this function of the liver exercises a general protective influence as already sufficiently mentioned in connection with the lungs.

The comparative rarity of kidney disturbance is also due to a similar action in blood purification. Dr. Letheby has shown that poisonous doses of arsenic may be repeatedly given to animals without injury, if a diuretic is administered at the same time. It is also the constant office of the kidneys to carry off urea, which, if retained, causes uræmic poisoning with its dangers. That these organs, however, should sometimes become the theatre of the morbid action, is not strange, from the constantly increasing blood pressure they must sustain under the work put upon them in disposing of the poison. Here the pathological incident is that known as acute catarrhal nephritis, an example of which has been given in the detailed case already here reported. The secreting cells are washed off, the tubules blocked up, and inflammatory changes ensue as may also take place in the parotid.

The testicles and ovaries, the organs most often selected in the secondary manifestations, present anatomical peculiarities which are possessed by no other organs in the body, save the liver and kidneys. They are furnished with a double set of capillary plexuses. It is plain that the greater the amount of vascular area of an organ, the greater is its liability to become impressed by a blood poison circulating through it. In the liver and kidneys this extra liability is amply offset by their previously noticed eliminatory action upon noxious products. Another anatomical condition bearing upon the selection of the testicles and ovaries is that they are located at the lowest portion of the body where gravity or anything opposing a hindrance to the onward flow of the blood current must operate upon them to the fullest extent. An erethism of these organs which exists in certain persons also predisposes to their involvement. Thus of twelve cases occurring in sailors on ship-board reported by Dr. Lynch (*Braithwaite's Retros.*, 1856–7, ii. 26), the testicles were affected in ten and the brain in two. It is sufficient to call attention to the increased excitability of the sexual organs in sailors, or the generality of men pent up or confined anywhere, to account for the preference manifested in these cases. It is also well attested by many observers that implication of the testicles is not nearly so common in children.

Why the right testicle should be selected in preference to the left, as noticed by Rilliet, we are not prepared to explain. This observer noticed that out of 23 cases the right side was affected 13 times, the left 6 times, and in 4 both testes suffered together. We would suppose the contrary to obtain, since upon the left side varicocele is twice as common as upon the right, due, as first pointed out by Brinton in this Journal, to the right spermatic vein being supplied with a valve at its outlet, while the left has none.

Ressiguer (*Gaz. Méd.*, 1850; *Med.-Chir. Rev.*, Oct. 1850) mentions a case under his observation where there was orchitis without parotiditis, but which subsequently developed. He also cites a similar case by Groffier. In reference to these cases it may be said that while parotid enlargement had not appeared, yet there was obstruction and interference with the secretion and systemic infection as shown by the affection of the testes.

The lymphatics are absorbents, and no time need be occupied in enlarging upon how readily the lymph glands are acted upon by matters taken to them by the lymphatics under systemic infection. The spleen, too, which is designated as a blood gland, must not rarely be disturbed by any impurity of the common nutritive fluid. How dependent the brain in the exercise of its functions is upon a pure circulating juice the most limited experience must appreciate. The cells of the gray matter cannot properly functionate upon depraved blood, and we may have all forms of disordered cerebral phenomena under such circumstances.

The mammary glands have been reserved to the last, and purposely. From what has been found written upon the subject we feel satisfied that secondary disturbances in these organs are among the rarest appearances of the disease. These glands are exposed not more or less to the morbid influence than other organs, which are among the least affected.

A word in regard to hypertrophies of the testicles and mammæ, which are mentioned as very rare sequelæ. It is of course a matter of not difficult demonstration that from pressure and distension of effusion, or from inflammatory changes, the special vital activity of a part becomes lost, and it hypertrophies, because the energy which was stored up in its structure has gone out of it.

Finally is reached the action of reputed remedies. How do they accord with the views herein advanced? Dr. Czernické reports (*Gaz. Hebd. de Méd. et Chir.*, No. 15, 1875; and *Clinic*, 1875) a case of orchitis from metastasis of mumps successfully treated by jaborandi. To the increased functional activity excited in the salivary glands by the sialagogue property of this drug is ascribed a diversion of the metastasis. Emery Desbrouses reports a similar case successfully treated by the same remedy. (Same Journal, April 30, 1875; also *Clinic*, 1875.) Dr. Eldridge, of New York, never fails to cure parotiditis by an emetic in 12 or 24 hours. (*Med. and Surg. Rep.*, vol. xxvi.)

Let us examine how effusion or dropsy occurs, and how absorption is produced. Under active vascular flow to an organ, as the parotid gland, the capillaries become dilated and permit free passage of blood through them into the veins; the arterial pressure is reduced, but venous pressure is enhanced. In the usual state of blood-flow there is some transudation of serum into the lymph spaces. This is constantly being removed by the capillary lymphatics, which, according to Recklinghausen, are everywhere distributed in the tissues in intimate relation with the bloodvessels through the lymph spaces. But where there is capillary repletion with exalted pressure in venous trunks, there is a greater amount of serum exuded into the lymph spaces than the lymphatics are competent to remove. When the secreting apparatus of the organ is in order, this surplus fluid is disposed of by appropriating it for secretion. But when the secretory structures are not operative, as in parotiditis, it accumulates in the lymph spaces or connective tissue, constituting effusion or dropsy.

It is, however, evident that this effusion can only increase to a certain extent. The pressure of the exuded fluid constricts the capillaries, exalts the pressure in the arteries and lowers it in the veins. The pressure exerted by the serum in the lymph spaces is now favourable to drainage through the lymphatic vessels, since hindrance to the flow through the lymph trunks has been obviated by removal of venous pressure. Compensatory channels of circulation have also become established, and these make tributary vessels from the overflowed district, and so assist in draining it. The effused fluid has also become thinner from a loss of its salts. When now there follows an increase in the blood-flow through the capillaries proper to the part, in consequence of removal of some of the effusion by the lymph vessels and compensatory channels, absorption into the blood takes place, although there is increased venous pressure. It occurs more rapidly, too, because the power of osmosis with which a thin liquid passes through into a denser is very great.

Such is the phenomena of effusion and absorption as it may occur anywhere. In the parotid gland, however, there is another favouring element in absorption to be considered. The washed-off cells, which in the first place cause the obstruction in the ducts, may be compared to bladders which are filled to bursting. Under the extreme of tension they burst, allow the contents of the tubes to be flushed out, and permit the new cells to exercise their function of secretion. Thus another important channel is opened for the relief of overflow.

We return now to the action of jaborandi and emetics. The time when such agents would be likely to be employed would be in the stage of greatest enlargement, just before the decline. Jaborandi is to be classed as an emetic. While it may exert a sialagogue and sudorific action without emesis, just so may ipecac., belonging to the emetic class, which is absorbed into the blood and acts precisely as jaborandi. They cause dilatation of, and retardation of flow through, the surface capillaries by paralysis of the sympathetic fibres distributed to them. Hence we have copious sweating and secretions from mucous surfaces.

In the case of parotid enlargement. The increased blood-pressure in the parts contiguous would tend to augment the pressure exerted upon the ducts and clear them of their obstruction by bursting the occluding cells. The secretory activity of the gland would also be stimulated through the afferent nerve fibres, by the taste impression, and also by the relaxation of the sympathetic. In this way the tubes would be flushed out and relieved of all impediment.

It is clear that this enhanced pressure in tegumental structures, which relieves itself by such remarkable overflow upon the surface and into the mucous passages, would exercise a powerful depletory effect upon any part the seat of effusion. It must speedily reduce the tumefaction, whether the organ possess within itself any active excretory office or not.